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# Rubric Assessment of Mathematical Processes in Homework

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# Rubric Assessment of Mathematical Processes in Homework


## Abstract

In this action research study of my classroom of 11th grade geometry, I investigated the use of rubrics to help me assess my students during homework presentations. I wanted to know more about the processes students went through as they did their homework problems, so homework presentations were implemented with the rubrics being the main form of assessment. I discovered that students are willing to speak about mathematics and can gain more understanding of mathematical processes as a result of homework presentations. The scores of the class improved after they talked about the homework assignments with each other. As a result of this research, I plan to keep on using homework presentations in my classroom to talk about homework, but discontinue the use of rubrics in assessment of students in mathematics. I also found students going to the board to solve problems in small groups are another helpful way to use presentations prior to assessment to help me understand where the students are with a new concept prior to assigning homework or giving an assessment.

## Introduction

I was interested in improving communication in my classroom with my students. There was definitely a lack of verbal and written communication in my classroom. I wanted to investigate if developing better the communication would improve math connections for the students. Previously, I had a monopoly on most of what is discussed in my classroom. The students were doing a lot of listening, but I did not get to hear their ideas. I have them write notes in class, but I wanted to see them justifying a solution on paper. Originally I was centered on the low-achieving student population in my class, but I realized that every student may benefit from this exposure to writing in math class.

At first I was puzzled by how I would begin to incorporate more writing into my math curriculum. My students just wrote numerical solutions and rarely responded with much gusto when I requested them to show their work on homework or assessments. I wanted to bring some writing into their homework assignments. Since homework was assigned usually three or four days of the week, there are many opportunities to begin writing. My focus of homework shifted away from the quantity of problems assigned to the quality of problems. Perhaps a blend of numerical solutions and written work would be beneficial to the students. I am interested to know if students can defend their solutions with either verbal or written explanation. By placing writing in assignments, I could better prepare my students for future connection in concepts. I definitely want to have my students' communication improve on assessments. Students' written responses could better show me a better picture of the connections they made from the material. If they really improved their connections, the homework would prepare them for the tests and quizzes.

## Problem Statement

I think that finding a way to improve communication about mathematics is worth knowing more. One thing that interests me most is finding out if students find a deeper understanding since they are required to talk and write about mathematics more often. I have experienced similar feelings in my educational background. The process may have been hard, but the end results were rewarding. Improved communication on my papers helped me retain understanding for the future. I would like my students to have a similar experience. If improved communication shows to be helpful for students to make connections, other teachers and students will benefit from similar experiences in their classrooms. When I did this action research, so much can be explored and discovered about teaching and learning.

It would be nice to also find out if writing about the problems and justifying a solution helps the students see connections. Could they improve assessment scores and standardized test scores by writing more in math? I want to shift my focus away from the numerical “right answer” to having students know and be able to explain why it is the right answer. Does a homework rubric exist that emphasizes the quality of correct solutions more than the quantity of correct solutions? The solution is still important, but the process of getting the solution, the connection, is what I am willing to pay more attention to. I believe this could benefit my students.

My research seemed to relate closely to two NCTM (2000) standards. To improve my teaching and learning, I found myself focusing on the NCTM process standards of communication and connections. I want to explore what my students feel is beneficial from sharing homework in class. I focused on the NCTM process standards of communication and connections for my own professional growth. I feel a problem in my classroom is the lack of

mathematical communication between the students and me. The role of communicating in my classroom fell heavily on my shoulders. I wanted to see this responsibility shared with the students. If I improved this relationship, perhaps there would be benefits for both sides. I hoped that I would learn things from knowing more about the students by improving the verbal and written communication.

## Literature Review

### Introduction

I am interested in improving communication and homework in my classroom, so I focused on these ideas for my three themes for the action research. First, I would like to initiate some oral communication on the students' behalf. The students can have the opportunity to reason and share their ideas. Written communication is a second theme I want to implement in my classroom. I will be examining several different types of written feedback of the students. My third theme is concerning communication and attitude connections. I have noticed a downward spiral in the work ethic in my room. I have developed a homework rubric to implement with student homework along with presentations to find out if it will help kids understand my expectations and where they fall within the guidelines.

### Oral Communication

One theme I chose to examine for my research is oral communication. There is a need for better communication in my classroom. I need to provide openings for my students to address concerns with the material before the assessment. I have many opportunities to change the way that I currently communicate with my students. There are frequent situations at assessment time that students ask questions like, "How do I do this?" and I wonder how I could have given them that answer before the test. At the assessment point I want them to be showing me what they

have learned from their homework and lesson. I wanted to give them time to clarify any questions to me or their classmates before independent work. I discovered that I do not give my students opportunities on a regular basis to ask questions. Austin (1980) conducted a study on homework in two college level statistics courses he taught at Rice University. He looked at allowing students questions on homework before or after homework is collected and its effect on student achievement. Students generally asked how to solve a particular problem, however, and not the specific answer to a problem. In class, when the students are given the opportunity to ask questions, it is usually before they hand in the paper. The students also usually ask about the process instead of the solution. My classroom is full of high school students, instead of college students, yet I may still be able to try different questioning tactics with the separate sections of the same course.

When I think about the ways to research homework in my classroom and the changes that I could make, it is quite overwhelming to know where to begin. According to Corno (1996), an educational researcher, the homework experience can be made a positive one if recommendations such as “assign more homework” are cast aside for thoughtful and well-supported strategies. Corno suggests that homework must be increasingly inspired by students’ own interests and motivations. Holding each student accountable for their homework with the knowledge that their homework matters is imperative (Heitzmann, 2007). Would my students be more successful if I implement homework presentations for the students? Can the student strengths and weaknesses be more apparent if I have them talk about homework problems? I would like to know more about what they are thinking by improving oral communication. I also want to do homework presentations to show them we are working on this with a purpose. Another beneficial teaching tool could be improving written communication.

**Written Communication**

More often than not, students want to know the solution and how they can find it in the calculator. Students do not seem as concerned with “why” and “how.” By being resourceful, students have examples in their notes and book that should be helpful. The next theme, communication and reasoning, were tied together since they seem more related in the classroom. I plan on finding a better way to communicate with the students.

To start accomplishing this, I created a homework rubric to use with the homework presentations. This tool would immediately tell a student where they stand in four important criteria points. In the current homework situation, there is not much reasoning thought out on paper. Through my experiences in Math in the Middle, I know now how much more important it is to talk about math. Schoen and Kreye (1974) conducted a study involving communication with elementary teachers. The teachers were in a mathematics course, and the researchers were looking at different feedback from check marks to comments involving the student’s first name and explicit explanation of the error. I had not thought of putting a personal attachment to the feedback I was giving the students. Perhaps this personalized help would cause them to pay more attention to what I am saying. It seems like their interest in the returned homework is so fleeting, that I need something to grab them. The sample for this study consisted of 147 prospective elementary school teachers enrolled in two large sections of a course in elementary mathematics concepts at two large universities. My sample consists of small sections of students ranging from four to 16 students. The personal attention factor is already more focused than in the first study. My methods have just not been strategic, organized and efficient prior to beginning my action research studies.

Reading about the ideas of other teachers and researchers provide many thoughts for ways to change my teaching methods. Corno (2000) states that much of when adults collaborate successfully, some children will share complementary ideas so well that the experience of working together on a school project can generate feelings of flow. Homework then becomes anything but a grind. One study showed that when students understand what teachers do to help them learn in school, like give reviews and summaries, then they become able to do this themselves. Once the teachers assume that their students possess sufficient classroom learning skills as they move up the grade ladder, they no longer provide the kinds of cues that were observed in the earlier grades. Students have to fend for themselves.

**Communication and Attitude Connection**

One of the questions I am asking myself is "What should I do as a teacher to help my students with homework?" I am interested in finding a way to help the students understand the relation between the homework and assessments, and also other interactions in the classroom. The studies of Corno (1996, 2000) provided a wealth of answers to this question. For older students, better assignments challenge them to develop expertise—in subject areas and also in studying and interacting with others. If teachers want youth to keep on learning on their own, then homework should communicate this. But the homework that accompanies such situations allows a teacher to emphasize attitudes, values, and other skills that are necessary in these contexts. Moreover, if teachers cue older students with critical questions when evaluating homework, then students will begin to learn the value of asking evaluative questions for themselves. Senk, Beckmann, and Thompson (1997) conducted a study with classroom mathematics teachers about assessment and grading. In all classes, performance on written tests or quizzes was the primary determinant of students' grades. Homework was the third most

important contributor to students' grades. Other types of assessment used included oral reports, group problem-solving, class work problems, and class participation. How can I make homework more of a contributing factor to my students' grades? I think that it would be beneficial to work on improving my requirements for homework with the four-part rubric. It will tell me more about the student work by looking at it differently, and convey my responses to the student in a clear fashion.

**Conclusion**

I believe that my three themes set up my action research to be a learning experience. Learning with understanding is essential to enable students to solve the new kinds of problems they will inevitably face in the future (NCTM, 2000). My students face a future where some of their occupations may not even be known, or even exist yet. When I require them to work through tough material, they are gaining critical thinking and problem solving skills by their struggling that empower them for the potential to do great things. I want to communicate with my students' in a different way, and in the end be a stronger teacher than before.

## Purpose Statement

The purpose of my action research project was to change the role of homework in my classroom. I aimed for the students to understand mathematical process and be able to explain their solutions. Homework would be assessed using a rubric and the focus would be on the process and not on the answers. I examined the variables of homework completion rate of the students, the quality of student reasoning (written) to solve word problems (measured by a rubric), the quality of student reasoning (oral) to present homework solutions at the board (measured by a rubric), and student engagement during homework presentations (measured by the quantity and quality of student-to-presenter questions) in seeking to answer my research

questions. I selected four research questions, with three of them addressing the behavior and work of students in my classroom. The fourth research question specifically addresses my teaching of mathematics.

- What will happen to students' abilities to communicate mathematical solutions when a rubric is used to assess homework?
- What will happen to students' justifications and completion of homework if the quantity of homework is reduced?
- What will happen to students' confidence level in understanding mathematical concepts? Will the completion rate change in classes?
- What happens to my teaching when I institute homework presentations?

## Method

To implement this study, I decided what data I would collect from my students. I was trying to improve communication in my classroom, so I selected student interview questions (Appendix A) to draw out student thoughts. When I conducted student interviews, I had four students from geometry class come to my room during my plan time. I conducted two interviews during the course of my research project on February 22 and March 28. I chose to interview twice to capture their thoughts at the beginning of the research and towards the end.

I also wanted examples of my student work (Appendix B) to compare their progress at various points of the study. I collected student work once every two weeks to ensure I had plenty of data to look at. Due to implementation of homework presentations, I wanted to look at the amount that students wrote on assignments. I did not look at every problem on each assignment. Instead I looked at one to two problems in each homework set.

Since I was writing a teacher journal during this research, I chose teacher journal questions (Appendix C) to guide my thoughts during the writing process. From the beginning I determined that I would write once a week on Friday after school. One reason I chose this time was because there were not many teachers who stayed around late on Fridays, so there would be few interruptions during the journal writing. To focus my writing, I kept notes of significant happenings during the week. This gave me a starting place for my journaling. I also would think about a research question to inspire and focus my writing process.

To assess the homework presentations, I made a rubric (Appendix D) that would look at the written work of the problem and how the students presented to their peers. This rubric was a collective effort I created with my peers, who were conducting similar research on homework presentations during the same time period. We decided on four areas that would be assessed during the homework presentations. I believed that this was a good fit for what I was going to be looking at with my research. I used it for each student when they did a homework presentation. The cumulative score was recorded in the grade book. The rubric grade for the homework presentation was different than the homework grade that was normally given during the course.

To gather the data, I set up a calendar of when I would gather specific data. By doing the calendar, I was continually doing something to help my research progress. If I did not have this device, I might have lost track of what I needed to do by becoming overwhelmed with the whole research project. I also created a spreadsheet in Excel (Appendix E) that helped me organize which students had presented to ensure that everyone had a turn, and what homework problem they shared with the class.

I decided to organize the data by my research questions. I selected a variety of data collection tools to help me with all of my research questions. I set up my research to parallel my

research questions. As I collected data, I analyzed it and wrote journal entries about my findings. I documented data during the entire process, and made adjustments where it was necessary.

## Findings

On a typical day of data collection, there were two or three students who were going to present their homework solution to one problem. I sat back by the students for the presentations, where I marked down the qualifications that were met on the rubric. This helped me do a quick score while the presentation was fresh in my mind. While the students were presenting, the other students in the class listened to the presentation and compared it with their own solutions. At times there were different ways to find the solution, so there was time to give any additional comments or ask questions once someone was done.

After the presentations were complete, I would collect the homework from the class, and we would begin a new lesson or continue with extra practice on the current material. When the students would work on the problems, I would circulate around the room to listen for any interesting conversations that I could journal about and answer any questions. Since my journaling day was on Friday, I would collect the notes I had from the week in my notebook, then expand on the ideas when I sat down to write at the end of the week.

Before giving the students the homework assignment, I would have them work on some similar problems in small groups. Group work freed me up to move around the room and answer fewer questions since the students had each other as resources to get help before asking me. Sometimes during this work time, I would have groups come up to the white boards and work on problems with me. At this time, it really helped some of my students to write their work on the board and be out of their seats. At the same time it showed me what steps they were taking towards a solution more quickly than walking around the room and peering over shoulders.

Taking this risk and changing how I taught lessons opened my room up to more communication than before. Prior to this research, I would present the lesson, help the students with notes, and give them some problems to work on individually at their desks. Before the students left for the day, I gave them a shorter homework assignment which focused more on problem solving than computation. When I was under the impression that longer homework assignments were the best, I noticed that more of the problems were brief computation problems that did not scratch the surface to challenge the students. There are some benefits to these problems, since they can show me at a quick glance if the students are comfortable with parts of the material. When I added more problem solving to the mix, there was more discussion and challenge for these students.

My teaching research question was "What happens to my teaching when I institute homework presentations?" I was looking for changes in my personal teaching style when I stepped back from the front of the classroom and let my students have some leadership. Students are now the center focus of my classroom.

I noted the following except in my journal.

> I have been looking at my classroom as an outsider might see it this afternoon. I am cleaning my room so it can be shown to the new superintendent. I see papers of student work displayed on the wall in big Post-It sheets. I see the work left behind of students working out some problems on the whiteboard in my room. I see desks pushed together where some students decided to initiate some homework discussions. This is so different from the utilitarian look it had before. (Personal Journal, March 21, 2008)

This entry appeared in my journal with my revelation to do something different.

> I love how teaching is all about trying out new ideas. One class was having a difficult time with a new concept. I was constantly moving from desk to desk, and there were so

> many questions. I told them to get up, grab a marker, and find some space at the whiteboard. We tried some problems together from our homework at the board, and the results amazed me. I was able to move around more freely to provide help and feedback, the students helped each other, and the whole mood lightened up. I think that I was putting "homework presentations" in too small of box. I think I stumbled upon a new way of "presenting homework" to the students. (Personal Journal, February 29, 2008)

This is another journal insight about the student-centered classroom.

> I have never stayed more than a year at any of my previous teaching jobs. Now that I am in the same position for another year, it is nice to remember what worked last year and what needs to change. I feel like I am out of the "survival mode" that consumes me, making my only goal to get through the year. Now that the material is familiar, I am willing to get out of my comfort zone. (Personal Journal, March 14, 2008).

When I originally focused on homework, I did not realize the extent that my teaching and classroom would be changed by relinquishing control to the students. It has been exhilarating to see how far the students have come in explaining their ideas verbally in homework presentations and written in their assignments. I know that I understand and can explain concepts to the students, but it is an entirely new experience to hear the students justify their work to myself and their peers.

My next research question was "What will happen to students' abilities to communicate mathematical solutions when rubric is used to assess homework?" Since I was using the NCTM communication standard for guidance, it made sense that this question focused on exploring the students' abilities to communicate. Prior to this research, I discussed the homework solutions, and I only graded the final outcome they presented on their homework paper. Students

communicate with each other more about math on the daily assignments since implementing homework presentations. This statement became apparent from evidence in my student interviews, my personal journal, and the student rubric homework grades.

During a student interview, Alan[1] had a comment on the use of homework presentations. I asked how homework presentations have been helpful. “I think that [homework presentations] have helped me talk about homework with the other students.”

Kiera responded, “I think I like [homework presentations] because it makes me care about my work. Before now I just wanted to know the answer instead of how the answer is right.”

Jane clarified, “Other people explaining it is really helpful. If I don’t know what to do, then I don’t want to work it out. Sometimes I take what I learned from one problem and use it with another problem.”

The responses of these students are representative of the class since I have students that were working at high, middle, and low levels. Alan is a very bright student who has admitted that math has always been pretty easy for him. One area he was needing improvement was talking and sharing his work with classmates. He usually wanted to get done and move onto the next problem. Homework presentations have opened him up to discussion, and he seems aware of this with his response about talking with other students. Kiera is a low math student that did not show much more than an answer prior to homework presentations. She seems to be more concerned about how to find the solution and her work. Jane is an average student in my room. She might have potential to perform at a higher level, but does only what is required. I liked her comment about applying knowledge from one problem to another, which is a helpful skill to have for a

[1] All names are pseudonyms.

problem solver. When I listened to the responses to this question, it was clear to me that homework presentations were helpful to all levels of students in my room.

I examined my grade book, and noticed that 90% of the students received passing grades on their homework presentations. I think that talking has been encouraged more, so my students are taking advantage of asking questions to clarify concepts more than they did previously. A presentation that did not receive a passing grade was usually unaccompanied by a picture to illustrate the problem. These pictures were usually very helpful when communication with the students became more open. The student who did not receive a passing grade provided only a solution to the problem, and did not explain *why* his solution is complete.

An excerpt from my journal shows how students are communicating better.

> When my students were at the board the other day, I noticed that Aaron, a struggling student, had taken a place by Danny, a student that performs above average in my class. We were pulling ourselves through a difficult concept, and I heard Aaron say to no one in particular, “I am too stupid to get this. I quit.” Danny finished his solution, turned to Aaron and said, “It was easy when I thought about it this way.” He proceeded to walk Aaron through the rest of the steps from where he stopped. I was so happy to hear the students support each other and talk. (Personal Journal, February 29, 2008)

I was pleased with the breakthroughs that took place during this time. My students are capable of explaining their ideas, and I was able to hear them share with each other during group work and homework presentations. If I did not move around my room to hear the discussion, I would have missed so many great conversations between the students that helped another progress. Collectively, through my personal journal, interviews, and rubric scores, these all showed there is more communication in my classroom from my students than before the

research. In the student interview, there was a positive response to how helpful homework presentations have been to these students. They talk more about their work and have a sense of pride in how well they are doing. From my journal, I tried to describe how different my room sounds and feels to me as the teacher. I know that my role is changing from the person that told the students every little step to someone who is quiet and watching what step they will take next. Overall, each piece of evidence I included seemed evident to support my assertion that students are now the focus of my classroom.

My next research question was "What will happen to students' justifications and completion of homework if the quantity of homework is reduced?" Prior to this research, a typical homework assignment consisted of 20 to 30 problems. These problems were usually a computational type of problem, where an algorithm or simple steps found the solution. When I considered reducing the homework, I was not necessarily considering the time that students put into their homework assignment. I was looking for more application problems that were tucked towards the back of the homework pages in my textbook. I decided to reduce my homework assignments to 10 to 15 problems that were a mix of computation and application problems. The quality of student work is greater when the amount of homework is reduced in the classroom. An excerpt from my journal shows how students are turning in better homework.

> I am pleased how the students are doing better on their homework. I am seeing the students write more to justify an answer, and the work is on the paper instead of lost in the calculators. I have been able to pinpoint where my students needed help with trigonometric ratios since they took the time to write everything down. Last year I remember students working in their heads, and I had no idea how they came up with the wrong answer. This is a pleasant change. (Personal Journal, March 7, 2008)

My students gave typical responses to the shortening of homework assignments in the student interviews and in class discussion. Amy commented, “I like that we have shorter assignments in geometry than algebra. I don’t rush to get finished since we have fewer problems to do. I guess I don’t worry about not getting done by the next class.”

In my geometry class, the homework is graded on a ten point scale. Since the implementation of homework, 9 out of 13 students have received a 9.5 or 10 on their homework assignment. This could be since there are fewer problems to complete; the students are better able to accomplish their homework goal everyday instead of leaving their work incomplete. In Appendix B, the work of Trey and Courtney demonstrate how the quality of homework improved. For these homework presentations, the students took the time to write out the problem, draw a picture with the known information, and show the set up to solve the unknown portion of the problem. Courtney even made a concluding statement at the end of her problem that was beginning to appear on many assignments of others in the class. Prior to this research, typically once the students got the correct answer, they stopped all work and moved on. Now they are taking the time to answer the questions from the homework problems.

My final research question was “What will happen to students’ confidence level in understanding mathematical concepts? Will the completion rate change in classes?” Prior to this research, I had an unusually high completion rate in my geometry class. I did not notice a difference when the students were given homework feedback through the rubric for presentations. The confidence level is something that is hard to measure with all of the tools that I had in my room. I had a basic feeling that the students were more comfortable, and perhaps more confident, but there is nothing measurable to tell me this. I found that receiving homework feedback on homework does not alter student’s homework completion rates.

In writing journals, the students have not really opened up to me. They seem to do better in the interview process. The best I could glean from the journals is this statement by Kiera, “I am more motivated to do my homework than I was before since I could have presentations about it in class.” Kiera did not have a completion problem before the research, but the quality of her work did improve.

In a student interview, I asked the students about homework completion, and Jenny said, “I try to get started in class, and look over the assignment in class to ask questions if I do not know where to begin.”

As I think about Jenny’s comment, is representative of others in the class. The students were more confident to know how to start their assignment. The students were not just writing down their assignment and putting it away to work on another time. Instead, they would look over the assigned problems and start to discuss where to begin in their groups. It was encouraging to see students open up to talk about math ideas instead of shying away.

An excerpt from my journal shows how my students are making slight improvements.

> From the beginning, I have most of the homework assignments get in on time. Each class has one or two that seem to be habitually late. More students are completing the answers with pictures, equations, and more habits of mind are used than before. It is hard to put a number with that, however, since it is more based on my teacher observation. I just saw that more students are passing their homework on the first attempt, rather than taking a late grade or having a redo assignment. (Personal Journal, April 4, 2008)

From the evidence that I collected, I found that students completed their homework more frequently and appeared to be more confident of their solution. It is hard to measure the confidence level of a person, but I tried to document in my journal how the students were

changing their attitude towards homework. When I would ask the students to explain *why* they knew this solution was right, they were comfortable providing me with complete solutions. An example of student work where confidence seemed more apparent is the work of Jenny. She struggled with the concept of triangle similarity and congruence. When she presented this problem to the class, I was impressed with how organized her solution was. She wrote out the original problem, illustrated the problem in a diagram, and wrote a nice concluding statement of why the triangles were similar and justified it at the end. Reading solutions like this shows me as a teacher how far students came during the year to use paragraph proofs in geometry with better flow than at the beginning of the year.

## Conclusions

As a teacher, my findings tell me several things about myself as a teacher. Previously, I was the only one sharing or talking for a majority of my classes. When I attempted different ways of having my students communicate with me in this research, I was elated to hear the thoughts and see the process of solving problems my students took for the homework assignments. Once I removed myself as the sole presenter and communicator in my classroom, my role changed. I discovered new ways to understand problem solutions from what the students were saying in their presentations. The responsibility of my students has changed as well. A correct solution is no longer enough. I requested and they provided justifications to solutions through words and pictures.

My findings support more than challenge other scholarly papers. The students were presenting homework solutions, so they knew they must be prepared to discuss. Heitzmann (2007) encouraged teachers to hold the students accountable for their homework to show it matters. Now they were not just writing down something; they needed to show how to solve it

correctly. Schoen and Kreye (1974) conducted a study involving homework feedback with elementary teachers. The elementary teachers were taking a mathematics course. Basically the more personal the feedback, the more attention the teachers would pay to their errors. Allowing each student to present, I gave them feedback through the rubric and made comments on their paper. The climate seemed to change by everyone being more supportive of learning.

## Implications

As a result of my study, I chose two actions I will take with regard to my classroom practice. The students will continue to take part in homework presentations. Implementing these into our classroom routine has been helpful for both the students and me. Homework presentations have been way to better utilize the instruction time that I have with the students. These presentations help guide my instruction for follow up lessons before the final assessment in a chapter or unit. I will continue having the students participate in board problems by going up to the whiteboard in small groups for more individualized instruction while the others complete seatwork. These board problems have helped the students work on a new objective without the pressures of a grade. They can make mistakes and improve their skills by working on the whiteboard prior to their assignment out of class.

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# Appendix A

Student Interview Questions

Interview Questions:

1. What is your attitude towards homework in the math classroom?

2. Has your attitude towards homework changed throughout the last six weeks? Please explain.

3. Why do you think teachers say it is important to complete homework and discuss solutions?

4. What helped you explain or understand math better? Why do you think that helped?

5. What could your teacher have done to help you with your homework?

6. How does completing and presenting homework help you learn math? Please explain.

7. How do you prepare to present a homework solution?

8. As I plan for how to do homework with my classes next year, what advice would you give me?

9. Is there anything else I should know about you to better understand your presenting experiences or your general math experience?

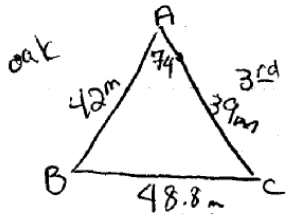
**Student Interview Questions**

1. How much time on average do you spend on homework assignments?
2. What do you think is the purpose of math homework?
3. Do you like doing homework presentations? Why or why not?
4. What does it look like when you justify your answers on a homework assignment?

5. What are the benefits of justifying your answers on your homework assignments, if any?
6. How successful do you feel about using Math skills in and out of class? Give an example of how you use Math outside of class.
7. What do you think about when your teacher asks questions during Math class?
8. What do you like best about Math? What do you like least about Math?
9. What makes math easy or difficult for you?
10. Have you ever had a really bad experience with math? If so, what happened? Please just tell me in general, without using names of teachers.
11. What could teachers do to help students with in math?
12. What would math class look like if you were in charge?
13. Is there anything you want to know from me?
14. Is there anything else I should know about you to better understand your problem solving in math or your general math experience?

**Appendix B**

(52) A realestate developer wants to build an office building on a triangular lot between Oak St. & 3rd Avenue. Use the diagram to find the measures of the angles formed by the sides of the lot.




$\frac{\sin 74}{48.8} = \frac{\sin C}{39}$

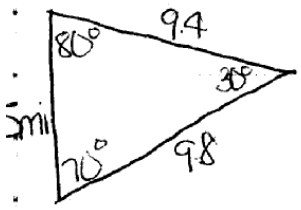
$\frac{39 \cdot \sin 74}{48.8} = \frac{48.8 \sin C}{48.8}$

$m\angle B = 56°$
$m\angle C = 50°$

$\angle B = 180 - 74 - 50$

By: Tracy Silver

A plume of smoke is spotted from 2 different fire towers that are 5mi apart. From tower A, the angle between the smoke plume & tower B is 80°. From tower B, the angle between the smoke plume & tower A is 70°. Which tower is closer to the smoke plume? How far is the smoke from the tower?




$\frac{\sin 30}{5} = \frac{\sin 80}{a}$ $\quad a = 9.8mi$

$\frac{\sin 30}{5} = \frac{\sin 70}{b}$ $\quad b = 9.4mi$

Tower A is closer
9.4mi.

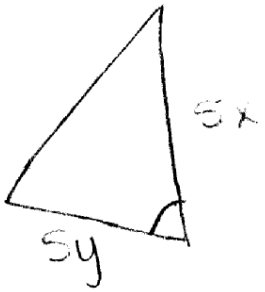
Courtney

**Jenny's work**

Problem: Miki copies one angle from the original triangle, then measures the 2 sides adjacent to that angle, and multiplies the lengths by 5. She then draws sides with those lengths adjacent to the copied angle and connects the endpoints to form a triangle. Will Miki's triangle be similar to the original?

Original Triangle

New Triangle




$\frac{1}{5x} = \frac{1}{5y}$

Yes, since the angle was kept the same and both side lengths were multiplied by the same amount it is similar by the SAS Theorem

# Appendix C

## Teacher Personal Journal for Action Research

**Reflection Questions**

1. How does each of the two incidents I wrote about relate to my research question(s)?
2. What changes have I seen in my students this week?
3. What surprised me this week, related to my problem of practice?
4. What went really well this week, related to my problem of practice?
5. What did I learn this week that will inform my teaching and/or journaling next week?
6. Tensions I felt this week between my roles as teacher & researcher:
7. What will happen to students' abilities to communicate mathematical solutions when a rubric is used to assess homework?
8. What will happen to students' justifications and completion of homework if the quantity of homework is reduced?
9. How can I help students see the importance of writing down their thoughts for solutions in mathematics?
10. What will happen to students' confidence level in understanding mathematical concepts if students provide feedback on their homework? Will the completion rate change in classes?

**Appendix D**

| Homework Presentation Rubric | | | | |
|---|---|---|---|---|
| Math Language | Communication | Readiness | Solution | Effort |
| 4<br>Student uses correct mathematical language and symbols throughout presentation. | 4<br>Complete response that is communicated effectively to the class | 4<br>Ready to present | 4<br>Answers questions correctly | 4<br>Student(s) made an excellent attempt to answer the problem and showed some excellent logic (may be incorrect) |
| 3<br>Student uses correct mathematical language and symbols throughout most of the presentation | 3<br>Complete response, but explanation may not be completely clear | 3<br>Ready to present | 3<br>Answers most questions correctly | 3<br>Student(s) made an attempt to answer the problem but gave up quickly |
| 2<br>Student does not use correct mathematical language and/or symbols throughout presentation | 2<br>Incomplete response, unclear explanation | 2<br>Not entirely ready to present, but makes the attempt | 2<br>Answers few questions correctly | 2<br>Student(s) made little attempt to complete the problem correctly |
| 1<br>Student does not use mathematical language | 1<br>No response | 1<br>Not ready to present | 1<br>No solution | 1<br>Student(s) does not attempt the problem |

Key:4- Advanced: Superior
3- Proficient: Satisfactory, with Minor Flaws
2- Progressing: Nearly Satisfactory, with Serious Flaws
1- Beginning: Unsatisfactory

# Appendix E

| **Homework Presentation Record** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Week 1 | | Week 2 | | Week 3 | | Week 4 | |
| Student Name | Date | Problem | Date | Problem | Date | Problem | Date | Problem |
| **5th Hour** | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| **8th Hour** | | | | | | | | |
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